

radical or mutilating surgery can be performed in many instances.

- vi) May-GrQnewald-Giemsa staining and a staining based on alcohol fixation (hematoxylin-eosin or Papanicolaou) often supplement each other and both should be used.
- vii) Embedding of FNA is useful for preservation of architecture (light microscopy) and for ultrastructural and immunohistochemical analysis.
- viii) FNA are well suited for DNA ploidy studies, cytogenetics, fluorescence *in situ* hybridization (FISH) and polymerase chain reaction (PCR) analyses.

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Fine needle aspiration of soft tissue tumors: The Mayo Clinic perspective

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Fine needle aspiration (FNA) biopsy of bone and soft tissue tumors has been in use at the Mayo Clinic since 1993. It was introduced in our routine practice due to the need for a fast diagnosis of bone and soft tissue sarcomas which would allow appropriate therapeutic management of the patients with high-grade sarcomas undergoing preoperative chemotherapy or radiotherapy in order to facilitate conservative surgical resections.

At the Mayo Clinic, the procedure for FNA is done at two different locations: at the outpatient building and at St. Mary's Hospital. The procedure is performed more frequently by a radiologist and less frequently by a surgeon. The pathologist does not perform the aspiration at the Mayo Clinic.

In approximately 80% of the cases, at least two passes are done. The first pass is done with a 23- or 24-gauge needle to obtain

fluid that is smeared and immediately fixed in alcohol. After the smears are obtained, a second pass is performed with a Tru-cut needle to obtain a fragment of tissue that is immediately put in saline. In several cases, more than two passes are performed and numerous smears and fragments of tissue are obtained. The smears and the tissue fragments are sent to the frozen section laboratory of each hospital where the smears are stained using a modified, fast Papanicolaou method; no Duff-Quick is performed. If the immediate examination of the smears yields a negative result, the biopsy fragment, or fragments, are frozen and examined until we obtain a positive diagnosis or confirm the negative result found with the examination of the smears. If the immediate examination of the Papanicolaou-stained smears yields a positive result, the tissue fragment, or fragments, are immediately placed in 10% formalin and routinely processed to permit the appropriate classification of the tumor, as well as to permit the use of ancillary techniques. The negative or positive result is immediately reported to the performing physician and the FNA procedure is repeated if the result does not correlate with the clinical findings. The next day, the final result is communicated to the patient's physician.

Since we have tissue available for examination in the vast majority of the cases, no cell block is necessary in our practice. In only a few cases, about 20% of the total number, only smears are sent with no tissue available. These cases correspond to cases in which a benign diagnosis, such as infection, is strongly suspected and in such cases, no tissue is available. Despite the fact that we have tissue fragments in almost every case, we report a nonbiased cytologic diagnosis in every case before the tissue fragment is examined.

From January 1, 1993 to December 31, 1996, we examined 222 FNA biopsies at the Mayo Clinic with 124 of them (56%) yielding positive results. Considering only the diagnosis of the Papanicolaou-stained smears, we had 52 false-negative (23.4%) cases. However, after the examination of the tissue, this figure dropped to 13 false-negative (5.9%) cases. The tumors that yielded false-negative cytologic results were 25 benign tumors and 27 sarcomas and the most common histopathological types associated with false-negative cytology were osteosarcoma, desmoid tumor and well-differentiated liposarcoma.

Considering only the recorded diagnosis of the Papanicolaou-stained smears, we had seven false-positive (3.2%) cases. These seven cases are the following: a hemangioma called suspicious for sarcoma; an aneurysmal bone cyst interpreted as giant cell tumor; a cellular schwannoma diagnosed as spindle cell sarcoma; a synovial chondromatosis in which the smears were considered consistent with chondrosarcoma; a glomus tumor that was erroneously interpreted as small round cell sarcoma; and two cases of abscesses with organization that were mistaken for possible spindle cell sarcomas. However, after the histopathological examination of the tissue fragments, just one of the seven cases was erroneously diagnosed. It was a cellular schwannoma showing mitotic activity and degenerative cellular atypia in which the examining pathologist failed to observe the misleading features and did not ask for an SiQO protein stain. The patient was operated on after receiving preoperative radiotherapy and the diagnosis of cellular schwannoma was rendered after the examination of the surgical specimen.

At the Mayo Clinic, we feel comfortable with the possibility of having tissue fragment(s) to corroborate the cytologic diagnosis and we strongly recommend its use since, in our hands, it is providing efficient results associated with no clinical complications.